

Japanese Kokai Patent Application No. P2001-211297A

Job No.: 228-95554

Ref.: JAPAN 2001-211297/PD020091 US/JJO/ORDER #6451

Translated from Japanese by the Ralph McElroy Translation Company

910 West Avenue, Austin, Texas 78701 USA

JAPANESE PATENT OFFICE
PATENT JOURNAL
KOKAI PATENT APPLICATION NO. P2001-211297A

Int. Cl. ⁷ :	H 04 N 1/19 G 06 T 1/00 H 04 N 1/028 1/04 G 06 F 15/64
Filing No.:	P2000-16949
Filing Date:	January 26, 2000
Publication Date:	August 3, 2001
No. of Claims:	23 (Total of 13 pages; OL)
Examination Request:	Filed

IMAGE READ DEVICE, METHOD AND STORING MEDIUM

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[There are no amendments to this patent.]

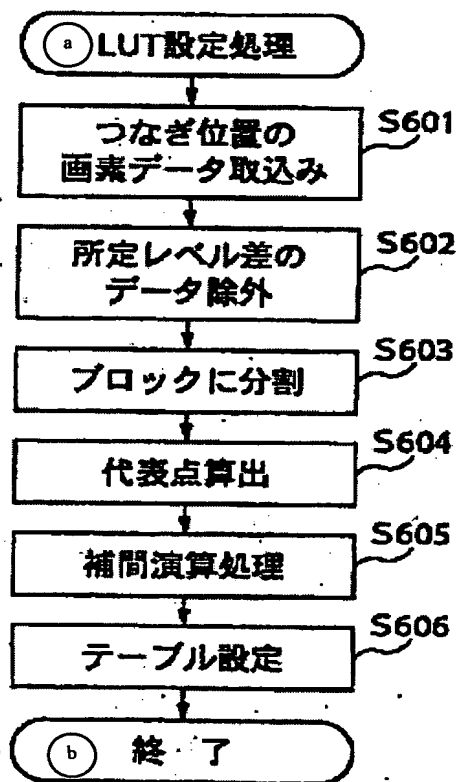
Abstract

Problem

The objective of this invention is to provide an image read device, method, and storing medium characterized by the fact that by reading each region, steps of the signal level are eliminated, and unnaturalness of the image can be eliminated.

Constitution

Pixel data of the connection position (P-VCK) are fetched and divided into plural blocks B by means of the signal level of output pixel signal ODD-2; in each said block, average value AV-ODD-1 of ODD-1 values of the data inside region AS and average value AV-ODD-2 of ODD-2 values are calculated; and the points defined by said two average values AV-ODD-1, 2 are taken as representative points (ratio of the two average values). By means of an interpolation calculation from the obtained representative points, a curve indicating the relationship between output pixel signals ODD-1, 2 over the entire signal level region is obtained. Based on said curve, the content of lookup table LUT-3 is determined and is set in connection correcting circuit (513). For the actual output pixel signal ODD-2 (input), level adjustment is performed based on table LUT-3, and the level is made to almost agree with the signal level of output pixel signal ODD-1.



- Key:
- a LUT setting treatment
 - b END
 - S601 Fetching of pixel data of connection position
 - S602 Exclusion of data with prescribed level difference
 - S603 Dividing into blocks
 - S604 Calculation of representative points

S605 Interpolation arithmetic treatment
S606 Setting of table

Claims

1. A type of image read device characterized by the fact that an image read device that uses a linear image sensor to read images has the following means:

a read means, which divides the region of the light receiving pixel row of said linear image sensor into a reference region and at least one other region, and which reads the output pixel signals of the two regions in these regions, respectively;

and an adjusting means that adjusts the signal level of the output pixel signal of said other region to be nearly in agreement with the signal level of the output pixel signal of said reference region based on the output pixel signals of said two regions read with said read means.

2. The image read device described in Claim 1 characterized by the fact that said adjusting means compares the output pixel signals of said reference region and said other region in the vicinity of a boundary position, and adjusts the signal level of the output pixel signal of said other region based on the result of said comparison.

3. The image read device described in Claim 2 characterized by the fact that said adjusting means has the following means: an estimating means that estimates the relationship between the signal level of said reference region and the signal level of said other region based on the ratio of signal levels of the output pixel signals of said reference region and said other region in the vicinity of the boundary position;

and a correcting means that corrects the output pixel signal of said other region based on the result of estimation with said estimating means.

4. The image read device described in Claim 3 characterized by the fact that said estimating means calculates said signal level ratio of the output pixel signals in said reference region and said other region for each of plural level regions divided according to signal level of the output pixel signals of said other region in the vicinity of the boundary positions with said reference region.

5. The image read device described in Claim 4 characterized by the fact that when plural output pixel signals of said other region exist in the same level region in the vicinity of the boundary position with said reference region, said estimating means calculates the average value of the output pixel signals of said other region in the same level region, and calculates said signal level ratio based on the calculated average value.

6. The image read device described in Claim 4 or 5 characterized by the fact that when less than a prescribed number of output pixel signals of said other region exist in the same level region in the vicinity of the boundary position with said reference region, said estimating means

prohibits calculation of the average value of the output pixel signals of said other region in said same level region and of said ratio of signal levels.

7. The image read device described in any of Claims 3-6 characterized by the fact that when the difference between two output pixel signals in the vicinity of the boundary position between said reference region and said other region is larger than a prescribed value, said estimating means excludes the two output pixel signals from those for calculating said signal level ratio.

8. The image read device described in any of Claims 4-7 characterized by the fact that for a level region free of output pixel signals of said other region in the vicinity of the boundary position with said reference region, said estimating means determines said signal level ratio in said level region by means of an interpolation calculation.

9. The image read device described in any of Claims 3-8 characterized by the fact that when output pixel signals of said other region in the vicinity of the boundary position with said reference region are newly obtained by reading the image of a new read object, said estimating means updates said signal level ratio in the level region corresponding to said output pixel signals based on the newly obtained output pixel signals.

10. The image read device described in any of Claims 1-9 characterized by the fact that the gradation number of the image in the output pixel signals after adjustment of the signal level with said adjusting means is set at a value smaller than the gradation number of the image in the output pixel signals before adjustment of the signal level with said adjusting means.

11. The image read device described in any of Claims 1-10 characterized by the fact that it has a shading correcting means that performs shading correction for the output pixel signal read with said read means, and adjustment with said adjusting means is performed for the output pixel signal after said shading correction with said shading correcting means.

12. An image read method characterized by the fact that in an image read method for reading images with a linear image sensor, there are the following steps of operation:

a read step in which the region of the light receiving pixel row of said linear image sensor is divided into a reference region and at least one other region, and the output pixel signals of the two regions are read in these regions, respectively;

and an adjusting step in which the signal level of the output pixel signal of said other region is adjusted to be nearly in agreement with the signal level of the output pixel signal of said reference region based on the output pixel signals of said two regions read with said read means.

13. The image read method described in Claim 12 characterized by the fact that the output pixel signals of said reference region and said other region in the vicinity of a boundary position are compared with each other, and the signal level of the output pixel signal of said other region is adjusted based on the result of said comparison.

14. The image read method described in Claim 13 characterized by the fact that said adjusting step has the following steps: an estimating step in which the relationship between the signal level of said reference region and the signal level of said other region is estimated based on the ratio of signal levels of the output pixel signals of said reference region and said other region in the vicinity of the boundary position; and a correcting step in which the output pixel signal of said other region is corrected based on the result of estimation with said estimating means.

15. The image read method described in Claim 14 characterized by the fact that in said estimating step, said signal level ratio of the output pixel signals in said reference region and said other region is calculated for each of the plural level regions divided according to signal level of the output pixel signals of said other region in the vicinity of the boundary position with said reference region.

16. The image read method described in Claim 15 characterized by the fact that when plural output pixel signals of said other region exist in the same level region in the vicinity of the boundary position with said reference region, in said estimating step, the average value of the output pixel signals of said other region in the same level region is calculated, and said signal level ratio is calculated based on the calculated average value.

17. The image read method described in Claim 15 or 16 characterized by the fact that when less than a prescribed number of output pixel signals of said other region exist in the same level region in the vicinity of the boundary position with said reference region, in said estimating method, calculation of the average value of the output pixel signals of said other region in said same level region and of said ratio of signal levels is prohibited.

18. The image read method described in any of Claims 14-17 characterized by the fact that when the difference between two output pixel signals in the vicinity of the boundary position between said reference region and said other region is larger than a prescribed value, in said estimating step, the two output pixel signals are excluded from those for calculating said signal level ratio.

19. The image read method described in any of Claims 15-18 characterized by the fact that for a level region free of output pixel signals of said other region in the vicinity of the boundary position with said reference region, in said estimating step, said signal level ratio in said level region is determined by means of an interpolation calculation.

20. The image read method described in any of Claims 14-19 characterized by the fact that when output pixel signals of said other region in the vicinity of the boundary position with said reference region are newly obtained by reading the image of a new read object, in said estimating step, said signal level ratio in the level region corresponding to said output pixel signals is updated based on the newly obtained output pixel signals.

21. The image read method described in any of Claims 12-20 characterized by the fact that the gradation number of an image in the output pixel signals after adjustment of the signal level in said adjustment step is set at a value smaller than the gradation number of the image in the output pixel signals before adjustment of the signal level with said adjusting means.

22. The image read method described in any of Claims 12-21 characterized by the fact that it has a shading correcting step, in which shading correction is performed for the output pixel signal read with said read means, and adjustment with said adjusting means is performed for the output pixel signal after said shading correction with said shading correcting means.

23. A type of storing medium characterized by the fact that in a storing medium that stores a program used in an image read method for reading images using a linear image sensor, the following codes are stored:

the codes of a read step in which the region of the light receiving pixel row of said linear image sensor is divided into a reference region and at least one other region, and the output pixel signals of the two regions are read in said regions, respectively;

and the codes of an adjustment step in which the signal level of the output pixel signal of said other region is adjusted to be nearly in agreement with the signal level of the output pixel signal of said reference region based on the output pixel signals of said two regions read with said read means.

Detailed explanation of the invention

[0001]

Technical field of the invention

This invention pertains to a type of image read device for reading images using a linear image sensor, as well as its method and storing medium.

[0002]

Prior art

In the prior art, an image read device for reading images using a linear image sensor exists.

[0003]

Figure 12 is a diagram illustrating the constitution of the linear image sensor in a conventional image read device.

[0004]

As shown in this figure, (101) represents a light receiving pixel row; (102) and (103) both are analog shift registers. (104) and (105) both are output amplifiers, and they convert the charges read from analog shift registers (102), (103) and output obtained voltage signals. The charges accumulated in the various pixels of light receiving pixel row (101) of the linear image sensor are divided into ODD (odd-number) pixels and EVEN (even-number) pixels, which are sequentially read with analog shift registers (102), (103), and are output as pixel signals (ODD, EVEN) from output amplifiers (104), (105), respectively.

[0005]

Also, as shown in Figure 1, when an original is read, original (202) carried on original table glass (platen glass) (201) is illuminated with illuminating lamp (203). The light reflected from the original is guided by first mirror (204), second mirror (205), and third mirror (206) to lens (207), and forms an image on the light receiving plane of linear image sensor (208). Also, by means of dummy glass (210), the plane of white plate (209) and the plane of original (202) are at the same optical distance as viewed from linear image sensor (208), and white plate (209) is read. Based on the read signal taken as a reference, shading correction treatment is carried out for the original image.

[0006]

In this way, when an original is read, as mirrors (204), (205), (206) are driven to move in secondary scanning direction S, image sensor (208) can 2-dimensionally read the image of original (202). Also, by dividing the charges accumulated in the various pixels of light receiving pixel row (101) into an ODD (odd-number) and EVEN (even-number), it is possible to increase the read speed by means of analog shift registers (102), (103), which have limit in the transfer speed.

[0007]

In recent years, efforts have been made to further increase the read speed. For the linear image sensor proposed as shown in Figure 2, four analog shift registers are used to divide and read ODD (odd-number) and EVEN (even-number), and to divide the light receiving pixel row into left/right for reading.

[0008]

That is, as shown in Figure 2, light receiving pixel row (301) of image sensor (208) is bisected left/right with a boundary at the center. Charges accumulated in the pixels of left-side

light receiving pixel row (301L) (reference region) are divided into ODD pixels and EVEN pixels, and the charges of the ODD pixels and EVEN pixels are read from analog shift registers (302), (304), and pixel signals (ODD-1, EVEN-1) are output from output amplifiers (306), (308). In the same way, charges accumulated in the various pixels of right-side light receiving pixel row (301R) (another region) are divided into ODD pixels and EVEN pixels, and these are read from analog shift registers (303), (305), and pixel signals (ODD-2, EVEN-2) are output from output amplifiers (307), (309).

[0009]

With this constitution, compared with an image read device that simply divides into ODD (odd-number) and EVEN (even-number) for reading, the read speed is doubled.

[0010]

Problems to be solved by the invention

For the aforementioned conventional image read device having a linear image sensor with a structure, in which the light receiving pixel row is divided into left/right for reading in addition to a division reading scheme, 4 channels of output signals are generated. However, in the output signals of the various channels, there is a small difference in the linearity. Consequently, a step occurs in the read signal level with a boundary at the left/right division position, so that the displayed image is significantly affected, and the displayed image becomes unnatural. This is undesired.

[0011]

That is, for the device type that simply divides into ODD (odd-number) and EVEN (even-number) for reading, even when a difference takes place in the read signal level between ODD and EVEN, only a minute repeating pattern is added on the displayed image and it is insignificant. On the other hand, for the device type that also divides the light receiving pixel row into left/right for reading, even if there is a small step quantity in the read signal level with the left/right dividing position as the boundary, since the displayed image is divided into upper/lower portions with the step portion as the boundary, the boundary line becomes highly significant, and the displayed image becomes unnatural.

[0012]

The objective of this invention is to solve the aforementioned problems of the prior art by providing a type of image read device, which performs read for each region so as to eliminate a

[0017]

The image read device described in Claim 5 pertains to the image read device described in Claim 4 characterized by the fact that when plural output pixel signals of said other region exist in the same level region in the vicinity of the boundary position with said reference region, said estimating means calculates the average value of the output pixel signals of said other region in the same level region, and calculates said signal level ratio based on the calculated average value.

[0018]

The image read device described in Claim 6 pertains to the image read device described in Claim 4 or 5 characterized by the fact that when less than a prescribed number of the output pixel signals of said other region exist in the same level region in the vicinity of the boundary position with said reference region, said estimating means prohibits calculation of the average value of the output pixel signals of said other region in said same level region and of said ratio of signal levels.

[0019]

The image read device described in Claim 7 pertains to the image read device described in any of Claims 3-6 characterized by the fact that when the difference between two output pixel signals in the vicinity of the boundary position between said reference region and said other region is larger than a prescribed value, said estimating means excludes the two output pixel signals from those for calculating said signal level ratio.

[0020]

The image read device described in Claim 8 pertains to the image read device described in any of Claims 4-7 characterized by the fact that for a level region free of output pixel signals of said other region in the vicinity of the boundary position with said reference region, said estimating means determines said signal level ratio in said level region by means of an interpolation calculation.

[0021]

The image read device described in Claim 9 pertains to the image read device described in any of Claims 3-8 characterized by the fact that when output pixel signals of said other region in the vicinity of the boundary position with said reference region are newly obtained by reading the image of a new read object, said estimating means updates said signal level ratio in the level

region corresponding to said output pixel signals based on the newly obtained output pixel signals.

[0022]

The image read device described in Claim 10 pertains to the image read device described in any of Claims 1-9 characterized by the fact that the gradation number of the image in the output pixel signals after adjustment of the signal level with said adjusting means is set at a value smaller than the gradation number of the image in the output pixel signals before adjustment of the signal level with said adjusting means.

[0023]

The image read device described in Claim 11 pertains to the image read device described in any of Claims 1-10 characterized by the fact that it has a shading correcting means that performs shading correction for the output pixel signal read with said read means, and adjustment with said adjusting means is performed for the output pixel signal after said shading correction with said shading correcting means.

[0024]

This invention also provides an image read method described in Claim 12 and characterized by the fact that in an image read method for reading images with a linear image sensor, there are the following steps of operation: a read step in which the region of the light receiving pixel row of said linear image sensor is divided into a reference region and at least one other region, and the output pixel signals of the two regions are read in these regions, respectively; and an adjusting step in which the signal level of the output pixel signal of said other region is adjusted to be nearly in agreement with the signal level of the output pixel signal of said reference region based on the output pixel signals of said two regions read with said read means.

[0025]

The image read method described in Claim 13 pertains to the image read method described in Claim 12 characterized by the fact that the output pixel signals of said reference region and said other region in the vicinity of the boundary position are compared with each other, and the signal level of the output pixel signal of said other region is adjusted based on the result of said comparison.

[0026]

The image read method described in Claim 14 pertains to the image read method described in Claim 13 characterized by the fact that said adjusting step has the following steps: an estimating step in which the relationship between the signal level of said reference region and the signal level of said other region is estimated based on the ratio of signal levels of said reference region and said other region of the output pixel signals in the vicinity of a boundary position; and a correcting step in which the output pixel signal of said other region is corrected based on the result of estimation with said estimating means.

[0027]

The image read method described in Claim 15 pertains to the image read method described in Claim 14 characterized by the fact that in said estimating step, calculation of said signal level ratio of the output pixel signals in said reference region and said other region is calculated for each of plural level regions divided according to the signal level of the output pixel signals of said other region in the vicinity of the boundary position with said reference region.

[0028]

The image read method described in Claim 16 pertains to the image read method described in Claim 15 characterized by the fact that when plural output pixel signals of said other region exist in the same level region in the vicinity of the boundary position with said reference region, in said estimating step, the average value of the output pixel signals of said other region in the same level region is calculated, and said signal level ratio is calculated based on the calculated average value.

[0029]

The image read method described in Claim 17 pertains to the image read method described in Claim 15 or 16 characterized by the fact that when less than a prescribed number of output pixel signals of said other region exist in the same level region in the vicinity of the boundary position with said reference region, in said estimating method, calculation of the average value of the output pixel signals of said other region in said same level region and of said ratio of signal levels is prohibited.

[0030]

The image read method described in Claim 18 pertains to the image read method described in any of Claims 14-17 characterized by the fact that when the difference between two output pixel signals in the vicinity of the boundary position between said reference region and

said other region is larger than a prescribed value, in said estimating step, the two output pixel signals are excluded from those for calculating said signal level ratio.

[0031]

The image read method described in Claim 19 pertains to the image read method described in any of Claims 15-18 characterized by the fact that for a level region free of output pixel signals of said other region in the vicinity of the boundary position with said reference region, in said estimating step, said signal level ratio in said level region is determined by means of an interpolation calculation.

[0032]

The image read method described in Claim 20 pertains to the image read method described in any of Claims 14-19 characterized by the fact that when output pixel signals of said other region in the vicinity of the boundary position with said reference region are newly obtained by reading the image of a new read object, in said estimating step, said signal level ratio in the level region corresponding to said output pixel signals is updated based on the newly obtained output pixel signals.

[0033]

The image read method described in Claim 21 pertains to the image read method described in any of Claims 12-20 characterized by the fact that the gradation number of an image in the output pixel signals after adjustment of the signal level in said adjustment step is set at a value smaller than the gradation number of the image in the output pixel signals before adjustment of the signal level with said adjusting means.

[0034]

The image read method described in Claim 22 pertains to the image read method described in any of Claims 12-21 characterized by the fact that it has a shading correcting step, in which shading correction is performed for the output pixel signal read with said read means, and adjustment with said adjusting means is performed for the output pixel signal after said shading correction with said shading correcting means.

[0035]

The storing medium of this invention described in Claim 23 is characterized by the fact that in a storing medium that stores a program used in an image read method for reading images using a linear image sensor, the following codes are stored: the codes of a read step in which the

(502), (503), (504), respectively. The input output pixel signals are amplified with amplifiers (501), (502), (503), (504). AD converters (505), (506), (507), (508) convert analog signals to digital signals. Black offset correction treatment and shading correction treatment are performed as a black offset is subtracted by black offset + shading correcting circuits (509), (510), (511), (512).

[0046]

Connection correcting circuits (513), (514), (515) use lookup tables LUT-2, LUT-3, LUT-4 to be explained later to perform signal level conversion of the various signals of other output pixel signals EVEN-1, ODD-2, EVEN-2 with output pixel signal ODD-1 taken as a reference, and to realize connection correction (read level correction) of the left/right division reading. In addition to realization of connection correction, connection correcting circuits (513), (514), (515) also have the function of correcting read linearity. Here, connection correcting circuits (513), (514), (515) are set behind black offset + shading correcting circuits (510), (511), (512) in the treatment flow. Consequently, it is possible to realize constant read linearity without regard to the position of the principal scanning.

[0047]

Memory (516) temporarily stores the various output pixel signals output at the timing shown in Figure 4 to be explained later, and it realizes switched setting of pixels output alternately in the correct pixel order.

[0048]

DFF (517) and memory (518) can temporarily store the pixel data of the connection position shown in Figure 4 (with rise edge position indicated by P-VCK) and to be explained later so that they can be fetched into CPU (519). CPU (519) fetches the pixel data kept in memory (518) in plural rounds of reading of original (202), and, by means of an arithmetic treatment to be explained later (lookup table LUT shown in Figure 6), the setting contents of lookup tables LUT-2, LUT-3, LUT-4 for connection correction are determined. Also, the program executed by CPU (519) is stored in a ROM not shown in the figure.

[0049]

Figure 4 is a diagram illustrating schematically the output state of the output pixel signals from image sensor (208). The figure shows the pixel signals processed by black offset + shading correcting circuits (509), (510), (511), (512).

[0050]

In this figure, HSYNC is the line synchronizing signal. Rise edge position P-VCK defines the generating timing of the pixel signal at the boundary that divides the left/right portions of light receiving pixel row (301) of image sensor (208). Pixel signal Nos. 1-2n illustrate the order of the read pixel signals.

[0051]

As shown in the figure, output pixel signals ODD-1 and EVEN-1 from the left side of light receiving pixel row (301L) of image sensor (208) are sequentially read in an alternate way as number one and number two, and so on. After the n^{th} pixel signal of light receiving pixel row (301L) is read, output pixel signals ODD-2 and EVEN-2 from the right side of light receiving pixel row (301R) are sequentially read in an alternate way as number $n+1$ and number $n+2$, and so on, until the read of number $2n$. In this way, the effective pixel data of one line are obtained.

[0052]

As a result of said sequential read operation, at rise edge position P-VCK, output pixel signals ODD-1, EVEN-1, ODD-2, EVEN-2 are obtained as a continuous sequence up to numbers $n-1$ through $n+2$. The connection correction to be explained later is carried out using said pixel signals up to numbers $n-1$ through $n+2$. In this way, these signals are obtained from image positions near each other on original (202), and it is believed that the intrinsic signal levels of the signals are nearly equal to each other.

[0053]

Also, for pixel signals other than said numbers $n-1$ through $n+2$, by means of pixel signals near the dividing position of light receiving pixel row (301), an effect similar to this embodiment can be realized.

[0054]

Figure 5 is a diagram illustrating the relationship between the brightness (abscissa) of original (202) and the signal level of output pixel signals ODD-1, ODD-2 (ordinate). Figure 5(a) shows the signal level before connection correction, and Figure 5(b) shows the signal level after connection correction for output pixel signal ODD-2 based on output pixel signal ODD-1.

[0055]

As shown in Figure 5(a), because output pixel signals ODD-1, ODD-2 are converted to digital signals through entirely different circuits, such as output amplifiers (306), (307), etc.,

even when original (202) with the same brightness is read, there is still a certain difference in the read signal level ("Δ" in this figure). In this embodiment, output pixel signal ODD-1 is taken as a reference channel, and output pixel signal ODD-3 [sic; ODD-2] is converted with connection correcting circuit (514), so that its signal level reaches agreement with that of output pixel signal ODD-1 as shown in Figure 5(b). For output pixel signals EVEN-1, EVEN-2, the same level conversion is performed by means of connection correcting circuits (513), (515), so that the read signal level reaches agreement with the signal level of output pixel signal ODD-1.

[0056]

Connection correction performed with connection correcting circuits (513), (514), (515) is performed based on lookup tables LUT-2, LUT-3, LUT-4. For said lookup tables LUT-2, 3, 4, the contents are set by means of a lookup table (LUT) setting treatment to be explained later.

[0057]

Figure 6 is a flow chart illustrating the lookup table (LUT) setting treatment. In this treatment, setting treatment is performed for the content of lookup table LUT-3 for level adjustment of output pixel signal ODD-2 with output pixel signal ODD-1 taken as the reference channel. However, this is merely an example. For output pixel signals EVEN-1, EVEN-2, too, contents can be set for lookup tables LUT-2, LUT-4 for level adjustment with output pixel signal ODD-1 taken as the reference channel.

[0058]

First of all, the pixel data at the connection position are fetched (step S601). That is, during read of the original, the pixel data of rise edge position P-VCK shown in Figure 4 and kept in memory (518) are fetched. This fetching operation is performed in plural rounds during read of original (202).

[0059]

Figure 7 is a diagram illustrating the relationship between the signal level of output pixel signal ODD-1 and that of output pixel signal ODD-2 at the connection position.

[0060]

Then, in step S602 shown in Figure 6, pixel data with a prescribed level difference are excluded from the later arithmetic treatment. That is, data in the range of region AS shown in Figure 7 are taken as the effective data, and data outside region AS are not used in arithmetic treatment. As a result, the influence of accidentally obtained data on level correction can be

excluded. The range of region AS can be set considering a conventionally assumed level difference.

[0061]

Then, in step S603 shown in Figure 6, the signal level region is divided into plural blocks B (B1, B2, etc.) by means of the signal level of output pixel signal ODD-2 as shown in Figure 7.

[0062]

Then, in each block B, a representative point is calculated (step S604). That is, average value AV-ODD-1 of ODD-1 values of the data in region AS of each block B and average value AV-ODD-2 of ODD-2 value are calculated, and the point defined by two average values AV-ODD-1, 2 is taken as a representative point. The representative point is indicated by the ratio of the average value AV-ODD-1 to average value AV-ODD-2. In this case, when the number of data in region AS in each block B is smaller than a prescribed number (say, 2), the representative point in said block B is taken as invalid. As a result, it is possible to avoid an erroneous correction.

[0063]

Then, in step S605, an interpolation calculation is carried out. That is, from the aforementioned representative points, a conventional interpolation calculation is performed to determine the curve representing the relationship between output pixel signal ODD-1 and output pixel signal ODD-2 over the entire signal level region. As a result, the relationship between them is determined. In this interpolation calculation, because there are also blocks B for which a representative point is not determined, the calculation is performed using the representative point of a nearby block B.

[0064]

Figure 8 is a diagram illustrating an example of a curve representing the relationship between output pixel signal ODD-1 and output pixel signal ODD-2 calculated from the representative points by means of interpolation calculation. As shown in the figure, the corresponding relationship between output pixel signals ODD-1 and ODD-2 is obtained over the entire level region.

[0065]

Then, in step S606, the content of lookup table LUT-3 is set. That is, based on the curve indicating the relationship between output pixel signal ODD-1 and output pixel signal ODD-2

shown in Figure 8, the content of lookup table LUT-3 is determined, and it is set in connection correcting circuit (514).

[0066]

Figure 9 is a diagram illustrating an example of the content of lookup table LUT-3. This table LUT-3 indicates the adjustment which should be made corresponding to level region with respect to practical output pixel signal ODD-2 (input) such that it will agree with the signal level of output pixel signal ODD-1. Consequently, when output pixel signal ODD-2 input from black offset + shading correcting circuit (511) is corrected with correcting circuit (514) and output, the signal level is uniquely defined by table LUT-3.

[0067]

Then, this treatment comes to an end.

[0068]

In this embodiment, in the image read device with a constitution in which the region of the light receiving pixel row of linear image sensor (208) is divided into plural regions, and an output pixel signal is read for each region, the signal levels of the output pixel signals (ODD-2, EVEN-1, EVEN-2) of the other regions are adjusted with reference to output pixel signal ODD-1 so as to be nearly in agreement with the signal level of the reference output pixel signal. Consequently, steps in the signal level due to read for each region are eliminated, and unnaturalness of the image is eliminated. In this case, since level correction is performed based on the pixel signal of each region at the connection position, it is possible to effectively avoid a significant level difference by adjustment based on a signal level near the boundary position where a step occurs. In addition, as a representative point is calculated for each of the plural blocks B divided with respect to signal level, adjustment treatment of the signal level can be simplified.

[0069]

Also, data outside region AS are excluded from the data used in the treatment for setting the lookup table and when the number of data in region AS in a block B are smaller than a prescribed number, the representative point in said block B is not determined. Consequently, it is possible to avoid erroneous adjustment of the signal level, and to improve the adjustment precision. In addition, because blocks B where a representative point is not obtained are also included in determining the corresponding relationship (ratio) of output pixel signal ODD-1 to

the other output pixel signals ODD-2, EVEN-1, EVEN-2 by means of interpolation calculation, it is possible to perform level adjustment for the entire level region.

[0070]

The output pixel signal taken as reference is not limited to output pixel signal ODD-1. One may also use any other output pixel signals ODD-2, EVEN-1, or EVEN-2 as a reference. For example, level adjustment of output pixel signals ODD1, EVEN-1, EVEN-2 may be performed with reference to output pixel signal ODD-2.

[0071]

Also, even when there is a level difference in output pixel signal EVEN-1 with respect to output pixel signal ODD-1, as explained above, by simply adding a very fine repeating pattern on the displayed image, said level difference becomes insignificant. Consequently, the level adjustment with reference to output pixel signal ODD-1 may be performed only for output pixel signal ODD-2 and output pixel signal EVEN-2. Based on the same reasoning, level adjustment of output pixel signal ODD-2 can be carried out with reference to output pixel signal ODD-1, and level adjustment of output pixel signal EVEN-2 can be performed with reference to output pixel signal EVEN-2 [sic; EVEN-1] instead of output pixel signal ODD-1.

[0072]

In this embodiment, division is made into two regions (left/right regions). However, this invention is not limited to this scheme. According to this invention, division may also be made into plural regions.

[0073]

Embodiment 2

In Embodiment 1, a new lookup table is formed in each round of read of the original. Consequently, correction is performed with significant dependence on the original read in the preceding round. In Embodiment 2, in order to avoid this problem, the lookup table is renewed partially. Consequently, it differs from the table setting treatment in step S606 shown in Figure 6. The other constitution features are the same as those in Embodiment 1.

[0074]

Figure 10 is a diagram illustrating an example of the content of lookup table LUT-3 in this embodiment. Figure 10(a) shows the content before updating, and Figure 10(b) shows the content after updating.

[0075]

As explained above, representative points may not be obtained for all of the blocks B. Consequently, table setting treatment is performed by means of new representative points only for blocks B for which representative points were obtained. Updating is performed by determining the content of lookup table LUT-3 by means of said interpolation treatment with old representative points simply replaced with new representative points. The group of points p shown in Figure 10(b) are representative points after updating. Also, the same treatment is performed for lookup tables LUT-2, 4.

[0076]

Arithmetic treatment (such as weighted linear calculation) between old representative points and new representative points is performed to obtain updated representative points.

[0077]

In this embodiment, when the lookup table is set, it is possible to prevent excessive influence of the original read of the preceding round. Consequently, in addition to the same effects as those in Embodiment 1, an even better connection correction is obtained.

[0078]

Embodiment 3

Figure 11 is a diagram illustrating the constitution of the image read device in Embodiment 3 of this invention. The constitution of the image read device in this embodiment is basically the same as that of Embodiment 1. However, connection correcting circuit (900) is set between black offset + shading correcting circuit (509) and memory (516), and connection correcting circuits (913), (914), (915) replace connection correcting circuits (513), (514), (515). Connection correcting circuits (913), (914), (915) perform the connection correction in the same way as connection correcting circuits (513), (514), (515), and, further, conversion of the gradation number of the image (bit conversion) is also performed.

[0079]

From black offset + shading correcting circuits (510), (511), (512), 10-bit signals are input to connection correcting circuits (913), (914), (915), respectively, and the signals are converted here to 8-bit signals for output to memory (516). Also, from black offset + shading correcting circuit (509), a 10-bit signal is input to connection correcting circuit (900). After the lower 2-bit signal is cut off, the upper 8-bit signal is output to memory (516).

[0086]

In addition, the following function also may be realized. The program codes read from the storing medium are written in a function-expansion board inserted in a computer or in a function-expansion unit connected to a computer. Then, based on instruction of the program code, a CPU equipped in the function-expansion board or function-expansion unit executes a portion or all of the actual treatment. By means of this treatment, the function of the aforementioned embodiment can be realized.

[0087]

Effect of the invention

As explained above, by means of the image read device described in Claim 1, the image read method described in Claim 12 or the storing medium described in Claim 23, it is possible to eliminate steps on the signal level due to read of each region with a linear image sensor, and thus to eliminate unnaturalness of the image.

[0088]

By means of the image read device described in Claim 2 or the image read method described in Claim 13, it is possible to perform adjustment based on the portion where a step occurs, so as to effectively avoid a significant level difference and to eliminate unnaturalness of the image.

[0089]

By means of the image read device described in Claim 3 or the image read method described in Claim 14, it is possible to perform adjustment based on the signal level in the vicinity of the boundary position so as to eliminate unnaturalness of the image in an appropriate way.

[0090]

By means of the image read device described in Claim 4 or the image read method described in Claim 15, it is possible to adjust the signal level in a simple way.

[0091]

By means of the image read device described in Claim 5 or the image read method described in Claim 16, it is possible to improve the adjustment precision of the signal level, and to eliminate unnaturalness of the image.

[0092]

By means of the image read device described in Claim 6 or the image read method described in Claim 17, it is possible to avoid erroneous adjustment of the signal level.

[0093]

By means of the image read device described in Claim 7 or the image read method described in Claim 18, it is possible to avoid adjustment based on inappropriate data, and to eliminate unnaturalness of the image in an appropriate way.

[0094]

By means of the image read device described in Claim 8 or the image read method described in Claim 19, it is possible to perform adjustment for all output pixel signals in said other region.

[0095]

By means of the image read device described in Claim 9 or the image read method described in Claim 20, it is possible to prevent the influence of the read object that was read in the preceding round from becoming too significant.

[0096]

By means of the image read device described in Claim 10 or the image read method described in Claim 21, it is possible to reduce the load of the image read treatment while maintaining the precision of adjustment of the signal level.

[0097]

By means of the image read device described in Claim 11 or the image read method described in Claim 22, it is possible to adjust linearity of the output pixel signals after shading correction.

Brief description of the figures

Figure 1 is a diagram illustrating the constitution of the read portion of the image read device in Embodiment 1 of this invention.

Figure 2 is a diagram illustrating the constitution of the linear image sensor in said embodiment.

Figure 3 is a diagram illustrating the constitution of the treatment unit in the image read device in said embodiment.

Figure 4 is a diagram illustrating schematically the output state of output pixel signals from the image sensor in said embodiment.

Figure 5 is a diagram illustrating the relationship between brightness of the original (abscissa) and signal level of output pixel signals ODD-1, ODD-2 (ordinate) in said embodiment.

Figure 6 is a flow chart illustrating the lookup table (LUT) setting treatment in said embodiment.

Figure 7 is a diagram illustrating the relationship between the signal level of output pixel signal ODD-1 and that of output pixel signal ODD-2 at the connection positions fetched in said embodiment.

Figure 8 is a diagram illustrating an example of the curve showing the relationship between output pixel signal ODD-1 and output pixel signal ODD-2 calculated from the representative points by means of interpolation calculation in said embodiment.

Figure 9 is a diagram illustrating an example of the content of lookup table LUT-3 in said embodiment.

Figure 10 is a diagram illustrating an example of the content of lookup table LUT-3 in Embodiment 2.

Figure 11 is a diagram illustrating the constitution of the read portion of the image read device in Embodiment 3 of this invention.

Figure 12 is a diagram illustrating the constitution of the linear image sensor in a conventional image read device.

Explanation of symbols

202	Original
208	Linear CCD image sensor
301	Light receiving pixel row
301L	Light receiving pixel row (reference region)
301R	Light receiving pixel row (other region)
302, 303, 304, 305	Analog shift register (read means)
519	CPU (adjusting means, estimating means)
513, 514, 515	Connection correcting circuit (adjusting means, correcting means)

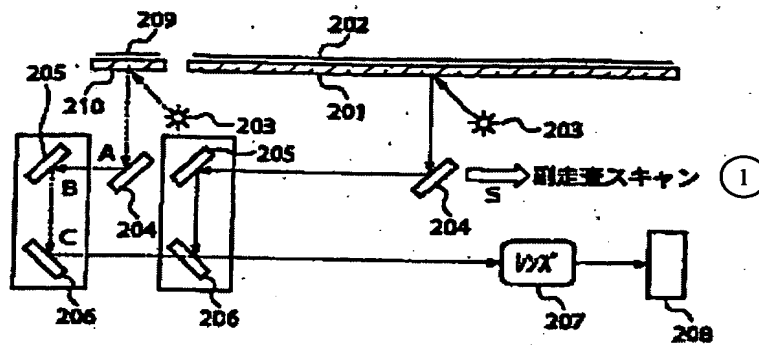


Figure 1

Key: 1 Secondary scanning
207 Lens

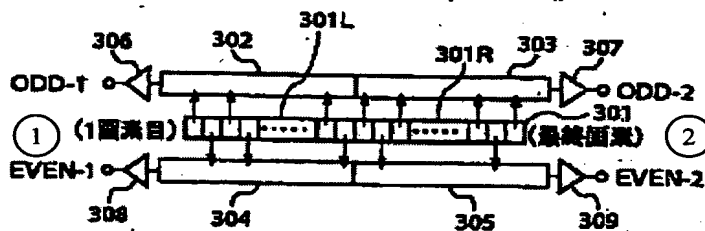


Figure 2

Key: 1 First pixel
2 Last pixel

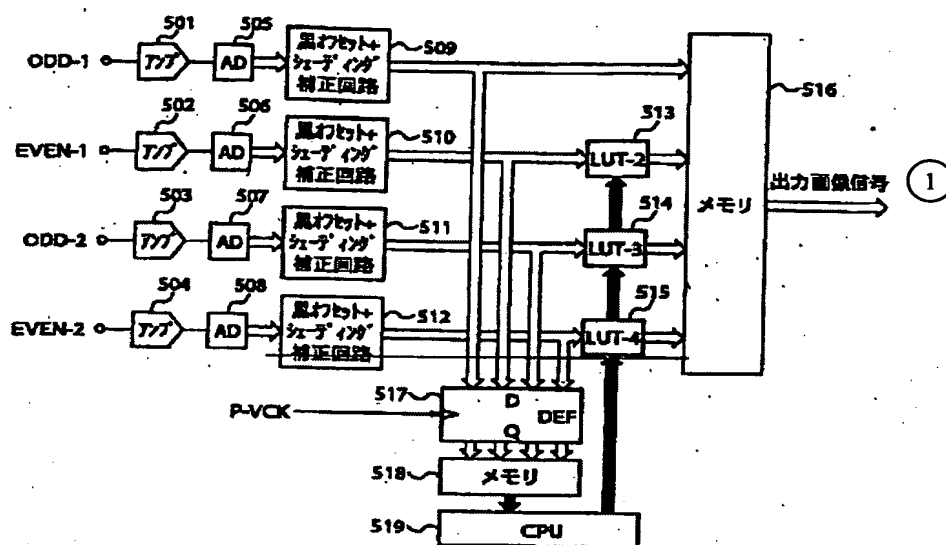


Figure 3

- Key: 1 Output image signal
 501-504 Amplifier
 509-512 Black offset + shading correcting circuit
 516 Memory
 518 Memory

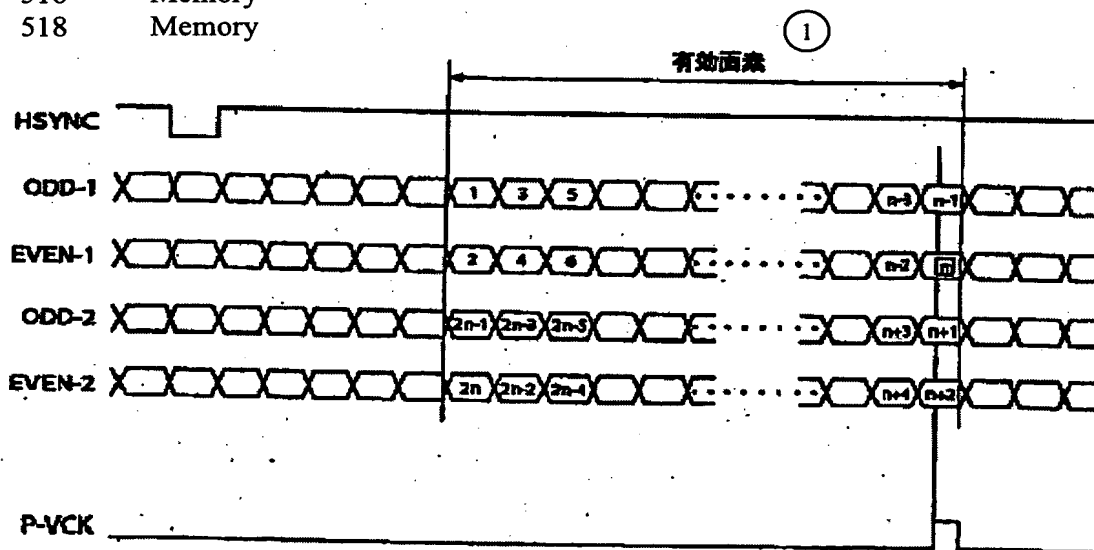


Figure 4

- Key: 1 Effective pixels

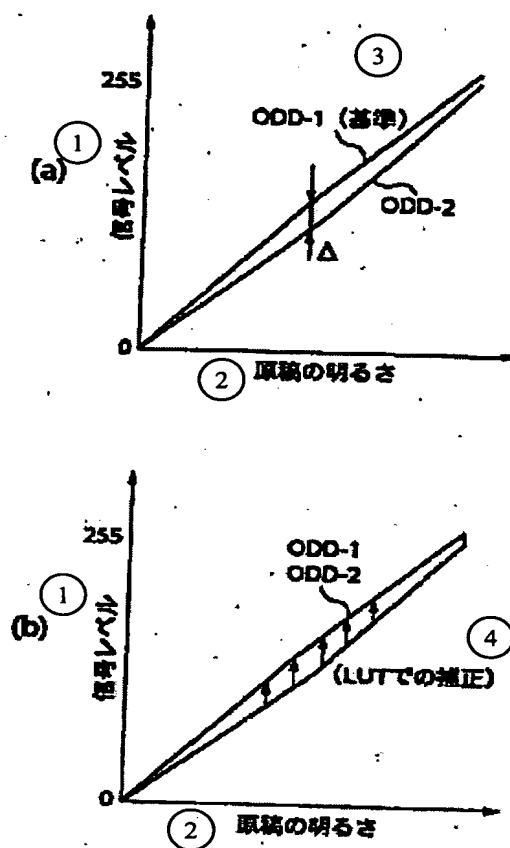


Figure 5

- Key:
- 1 Signal level
 - 2 Brightness of original
 - 3 Reference
 - 4 Correction in LUT

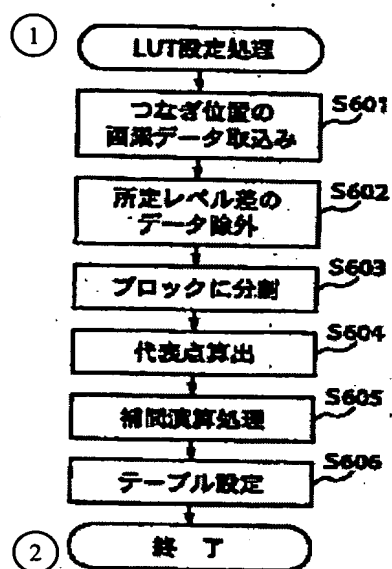


Figure 6

- Key: 1 LUT setting treatment
 2 END
 S601 Fetching of pixel data at connection position
 S602 Excluding of data with prescribed level difference
 S603 Dividing into blocks
 S604 Calculation of representative point
 S605 Interpolation calculation treatment
 S606 Setting of data

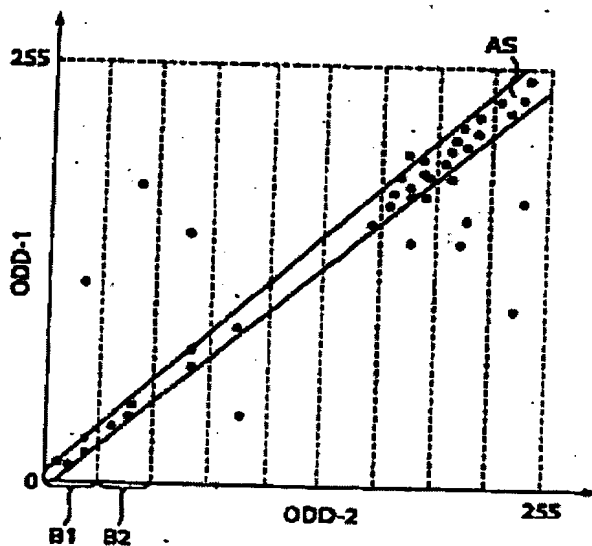


Figure 7

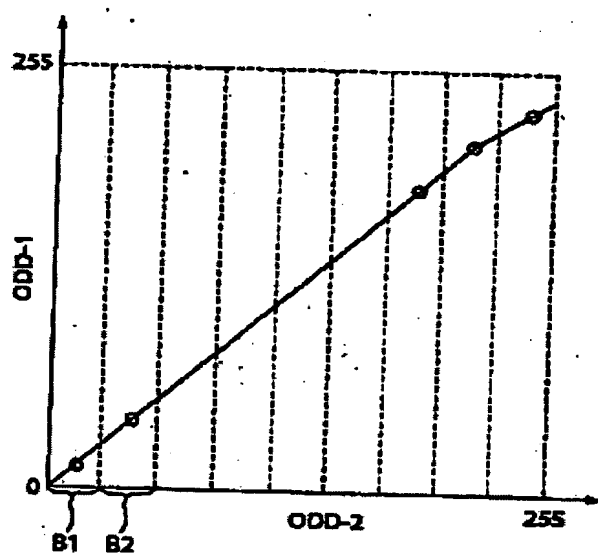


Figure 8

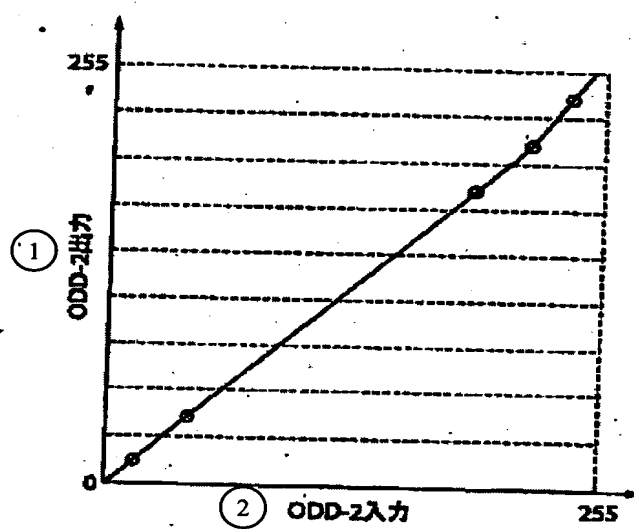


Figure 9

Key: 1 ODD-2 output
2 ODD-2 input

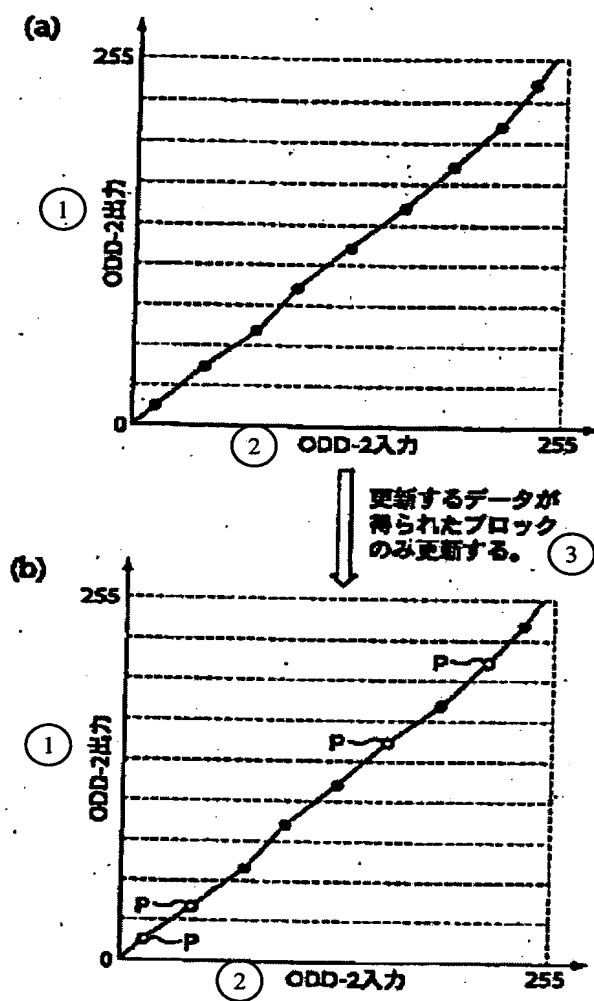


Figure 10

- Key: 1 ODD-2 output
 2 ODD-2 input
 3 Only blocks with obtained updated data are updated.

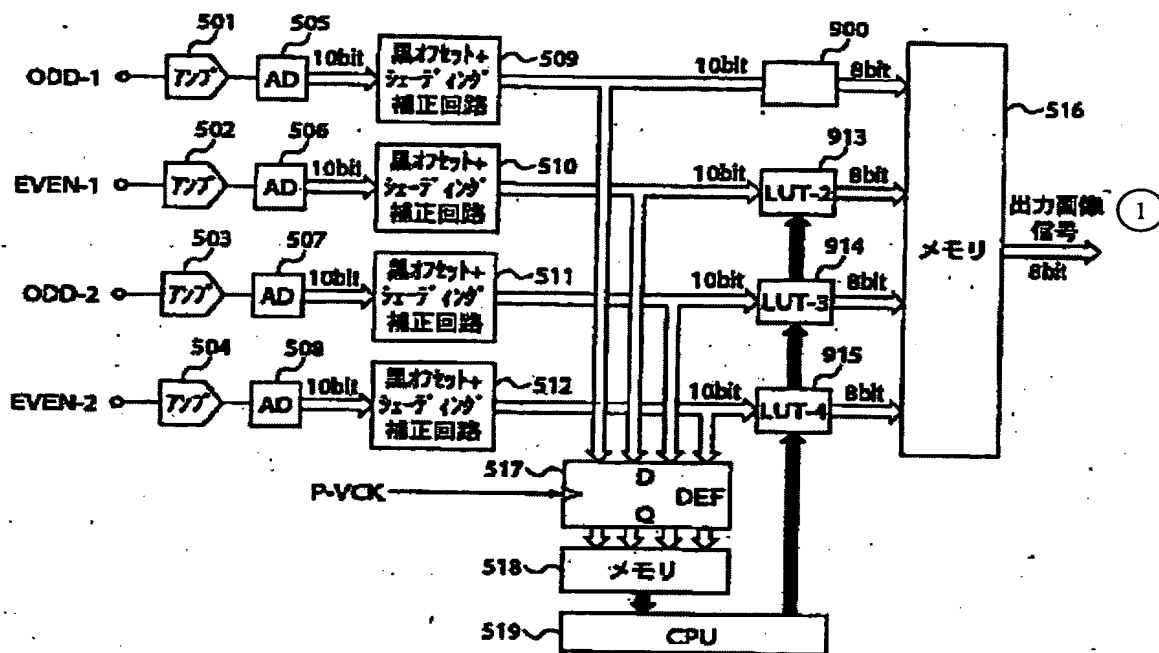


Figure 11

- Key: 1 Output image signal
 501-504 Amplifier
 509-512 Black offset + shading correcting circuit
 516 Memory
 518 Memory

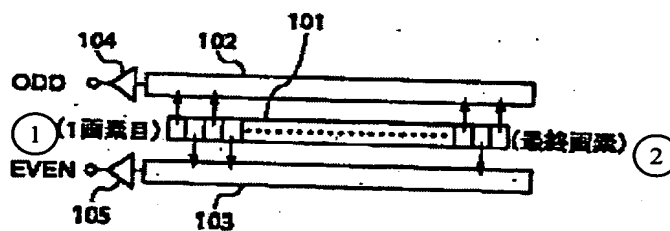


Figure 12

- Key: 1 First pixel
 2 Last pixel

(19)日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11)特許出願公開番号

特開2001-211297

(P2001-211297A)

(43)公開日 平成13年8月3日(2001.8.3)

(51)Int.Cl.

識別記号

F I

テ-ブ-ト(参考)

H 0 4 N 1/19

H 0 4 N 1/028

A 5 B 0 4 7

G 0 6 T 1/00

1/04

1 0 3 A 5 C 0 5 1

H 0 4 N 1/028

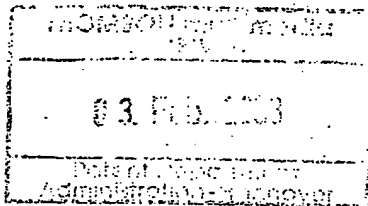
G 0 6 F 15/64

4 0 0 E 5 C 0 7 2

審査請求 有 請求項の数23, OL (全 13 頁)

(21)出願番号 特願2000-16949(P2000-16949)

(22)出願日 平成12年1月26日(2000.1.26)



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Fターム(参考) 5B047 A402 B803 BC16 CA12 DA06

5C051 AA01 BA03 DA03 DB35

5C072 AA01 BA17 EA05 FA05 FA07

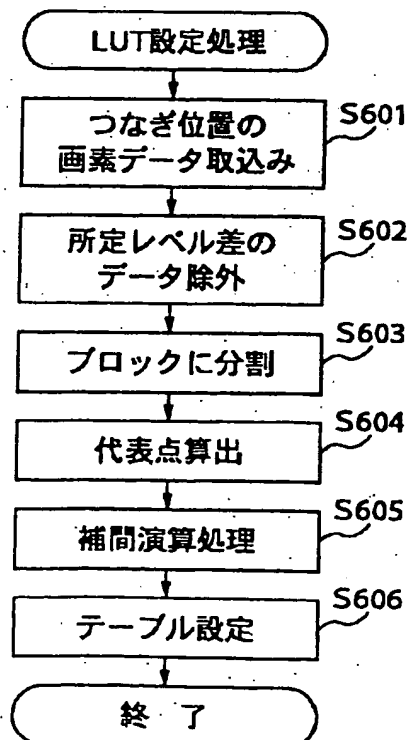
FB01 FB15 FB17 FB27

(54)【発明の名称】 画像読み取り装置、方法及び記憶媒体

(57)【要約】

【課題】 領域毎の読み出しによる信号レベルの段差をなくして画像の不自然さを解消することができる画像読み取り装置、方法及び記憶媒体を提供する。

【解決手段】 つなぎ位置(P-VCK)の画素データを取り込み、出力画素信号ODD-2の信号レベルによって複数に分割した各ブロックBにおいて、領域AS内にあるデータのODD-1値の平均値AV-ODD-1とODD-2値の平均値AV-ODD-2を算出し、両平均値AV-ODD-1、2で規定される点を代表点(両平均値の比)とする。得られた代表点から補間演算によって全信号レベル領域において出力画素信号ODD-1、2の関係を示す曲線を求め、これに基づいてルックアップテーブルLUT-3の内容を決定し、これをつなぎ補正回路513に設定する。実際の出力画素信号ODD-2(入力)に対してテーブルLUT-3に基づくレベル調整がなされ、出力画素信号ODD-1の信号レベルと略一致する。



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号レベルの比を算出することを特徴とする請求項14記載の画像読み取り方法。

【請求項16】 前記推定工程は、前記基準領域との境界位置近傍における前記他の領域の出力画素信号が同一のレベル領域に複数存在する場合は、該同一のレベル領域における前記他の領域の出力画素信号の平均値を算出し、該算出した平均値に基づき前記信号レベルの比を算出することを特徴とする請求項15記載の画像読み取り方法。

【請求項17】 前記推定工程は、前記基準領域との境界位置近傍における前記他の領域の出力画素信号が同一のレベル領域に所定数以上存在しない場合は、該同一のレベル領域における前記他の領域の出力画素信号の平均値及び前記信号レベルの比の算出を禁止することを特徴とする請求項15または16記載の画像読み取り方法。

【請求項18】 前記推定工程は、前記基準領域と前記他の領域との境界位置近傍における両出力画素信号の差が所定値以上である場合は、該両出力画素信号を前記信号レベルの比の算出に用いるデータから除外することを特徴とする請求項14～17のいずれか1項に記載の画像読み取り方法。

【請求項19】 前記推定工程は、前記基準領域との境界位置近傍における前記他の領域の出力画素信号が存在しないレベル領域については、該レベル領域における前記信号レベルの比を補間演算により求めることを特徴とする請求項15～18のいずれか1項に記載の画像読み取り方法。

【請求項20】 前記推定工程は、新たな読み取り対象物の画像が読み取られることにより、前記基準領域との境界位置近傍における前記他の領域の出力画素信号が新たに得られた場合は、該新たに得られた出力画素信号に基づき該出力画素信号に対応するレベル領域における前記信号レベルの比を更新することを特徴とする請求項14～19のいずれか1項に記載の画像読み取り方法。

【請求項21】 前記調整工程による信号レベルの調整後の出力画素信号における画像の階調数は、前記調整工程による信号レベルの調整前の出力画素信号における画像の階調数よりも小さい値に設定されることを特徴とする請求項12～20のいずれか1項に記載の画像読み取り方法。

【請求項22】 前記読み出し工程により読み出された出力画素信号にシェーディング補正を施すシェーディング補正工程を含み、前記調整工程による調整は、前記シェーディング補正工程によりシェーディング補正が施された後における出力画素信号に対してなされることを特徴とする請求項12～21のいずれか1項に記載の画像読み取り方法。

【請求項23】 リニアイメージセンサを用いて画像を読み取る画像読み取り方法で使用するプログラムを記憶した記憶媒体において、

前記リニアイメージセンサの受光画素列の領域を基準領域と少なくとも1つの他の領域とに分け、両領域の出力画素信号を各領域毎に読み出す読み出し工程のコードと、

該読み出し工程のコードにより読み出された前記両領域の出力画素信号に基づいて、前記他の領域の出力画素信号の信号レベルを前記基準領域の出力画素信号の信号レベルに略一致させるべく調整する調整工程のコードとを記憶したことを特徴とする記憶媒体。

【発明の詳細な説明】

【0001】

【発明の属する技術の分野】本発明は、リニアイメージセンサを用いて画像を読み取る画像読み取り装置、方法及び記憶媒体に関する。

【0002】

【従来の技術】従来、リニアイメージセンサを用いて画像を読み取る画像読み取り装置が知られている。

【0003】図12は、従来の画像読み取り装置におけるリニアイメージセンサの構成を示す図である。

【0004】同図において、101は受光画素列、102、103はいずれもアナログシフトレジスタである。104、105はいずれも出力アンプであり、アナログシフトレジスタ102、103から読み出される電荷をそれぞれ電圧信号に変換して出力する。リニアイメージセンサの受光画素列101の各画素に蓄積された電荷は、ODD（奇数）画素とEVEN（偶数）画素とに分離され、アナログシフトレジスタ102、103によって各々順番に読み出され、出力アンプ104、105からそれぞれ画素信号（ODD、EVEN）として出力される。

【0005】また、原稿読み取りの際には、図1に示すように、原稿台ガラス（プラテンガラス）201上に載置した原稿202を照明ランプ203によって照明し、その反射光を第1、第2、第3ミラー204、205、206によりレンズ207に導き、原稿画像をリニアイメージセンサ（208）の受光面に結像させる。なお、ダミーガラス210により、白色板209の面と原稿202の面とをリニアイメージセンサ（208）からみて同等な光学距離にして白色板209を読み取り、その読み取り信号を基準にして原稿画像に対してシェーディング補正処理を施すようにしている。

【0006】このように、原稿読み取り時には、各ミラー204、205、206が副走査方向Sに移動することで、イメージセンサ208が原稿202の画像を2次元的に読み取ることができる。また、受光画素列101の各画素に蓄積された電荷をODD（奇数）／EVEN（偶数）分離読み出しすることにより、転送速度に限界があったアナログシフトレジスタ102、103にて読み出し速度を向上している。

【0007】ところが、読み取り速度のさらなる向上が

号を前記信号レベルの比の算出に用いるデータから除外することを特徴とする。

【0020】同じ目的を達成するために本発明の請求項8の画像読み取り装置は、上記請求項4～7のいずれか1項に記載の構成において、前記推定手段は、前記基準領域との境界位置近傍における前記他の領域の出力画素信号が存在しないレベル領域については、該レベル領域における前記信号レベルの比を補間演算により求めることを特徴とする。

【0021】同じ目的を達成するために本発明の請求項9の画像読み取り装置は、上記請求項3～8のいずれか1項に記載の構成において、前記推定手段は、新たな読み取り対象物の画像が読み取られることにより、前記基準領域との境界位置近傍における前記他の領域の出力画素信号が新たに得られた場合は、該新たに得られた出力画素信号に基づき該出力画素信号に対応するレベル領域における前記信号レベルの比を更新することを特徴とする。

【0022】同じ目的を達成するために本発明の請求項10の画像読み取り装置は、上記請求項1～9のいずれか1項に記載の構成において、前記調整手段による信号レベルの調整後の出力画素信号における画像の階調数は、前記調整手段による信号レベルの調整前の出力画素信号における画像の階調数よりも小さい値に設定されることを特徴とする。

【0023】同じ目的を達成するために本発明の請求項11の画像読み取り装置は、上記請求項1～10のいずれか1項に記載の構成において、前記読み出し手段により読み出された出力画素信号にシェーディング補正を施すシェーディング補正手段を備え、前記調整手段による調整は、前記シェーディング補正手段によりシェーディング補正が施された後における出力画素信号に対してなされることを特徴とする。

【0024】同じ目的を達成するために本発明の請求項12の画像読み取り方法は、リニアイメージセンサを用いて画像を読み取る画像読み取り方法において、前記リニアイメージセンサの受光画素列の領域を基準領域と少なくとも1つの他の領域とに分け、両領域の出力画素信号を各領域毎に読み出す読み出し工程と、該読み出し工程により読み出された前記両領域の出力画素信号に基づいて、前記他の領域の出力画素信号の信号レベルを前記基準領域の出力画素信号の信号レベルに略一致させるべく調整する調整工程とを含むことを特徴とする。

【0025】同じ目的を達成するために本発明の請求項13の画像読み取り方法は、上記請求項12記載の構成において、前記調整工程は、前記基準領域と前記他の領域との境界位置近傍における各出力画素信号同士を比較し、その比較結果に基づいて前記他の領域の出力画素信号の信号レベルを調整することを特徴とする。

【0026】同じ目的を達成するために本発明の請求項

14の画像読み取り方法は、上記請求項13記載の構成において、前記調整工程は、前記基準領域と前記他の領域との境界位置近傍における各出力画素信号の信号レベルの比に基づいて前記基準領域の信号レベルと前記他の領域の信号レベルとの関係を推定する推定工程と、該推定工程による推定結果に基づいて前記他の領域の出力画素信号に対して補正を加える補正工程とを含むことを特徴とする。

【0027】同じ目的を達成するために本発明の請求項15の画像読み取り方法は、上記請求項14記載の構成において、前記推定工程は、前記基準領域との境界位置近傍における前記他の領域の出力画素信号の、信号レベルによって分割した複数の各レベル領域毎に、前記基準領域と前記他の領域との各出力画素信号の前記信号レベルの比を算出することを特徴とする。

【0028】同じ目的を達成するために本発明の請求項16の画像読み取り方法は、上記請求項15記載の構成において、前記推定工程は、前記基準領域との境界位置近傍における前記他の領域の出力画素信号が同一のレベル領域に複数存在する場合は、該同一のレベル領域における前記他の領域の出力画素信号の平均値を算出し、該算出した平均値に基づき前記信号レベルの比を算出することを特徴とする。

【0029】同じ目的を達成するために本発明の請求項17の画像読み取り方法は、上記請求項15または16記載の構成において、前記推定工程は、前記基準領域との境界位置近傍における前記他の領域の出力画素信号が同一のレベル領域に所定数以上存在しない場合は、該同一のレベル領域における前記他の領域の出力画素信号の平均値及び前記信号レベルの比の算出を禁止することを特徴とする。

【0030】同じ目的を達成するために本発明の請求項18の画像読み取り方法は、上記請求項14～17のいずれか1項に記載の構成において、前記推定工程は、前記基準領域と前記他の領域との境界位置近傍における両出力画素信号の差が所定値以上である場合は、該両出力画素信号を前記信号レベルの比の算出に用いるデータから除外することを特徴とする。

【0031】同じ目的を達成するために本発明の請求項19の画像読み取り方法は、上記請求項15～18のいずれか1項に記載の構成において、前記推定工程は、前記基準領域との境界位置近傍における前記他の領域の出力画素信号が存在しないレベル領域については、該レベル領域における前記信号レベルの比を補間演算により求めることを特徴とする。

【0032】同じ目的を達成するために本発明の請求項20の画像読み取り方法は、上記請求項14～19のいずれか1項に記載の構成において、前記推定工程は、新たな読み取り対象物の画像が読み取られることにより、前記基準領域との境界位置近傍における前記他の領域の

を減算する黒オフセット補正処理及びシェーディング補正処理が各々施される。

【0046】つなぎ補正回路513、514、515は、後述する各ルックアップテーブルLUT-2、LUT-3、LUT-4を用いて、出力画素信号ODD-1を基準として他の出力画素信号EVEN-1、ODD-2、EVEN-2の各信号の信号レベル変換を行い、左右分割読み出しのつなぎ補正（読み取りレベル補正）を実現するためのものである。つなぎ補正回路513、514、515は、つなぎ補正を実現するだけでなく、読み取りリニアリティを補正する機能を有する。ここでつなぎ補正回路513、514、515は、処理の流れ上、黒オフセット+シェーディング補正回路510、511、512の後段に夫々配置されているので、主走査の位置にかかわらず、一定の読み取りリニアリティを得ることができる。

【0047】メモリ516は、後述する図4に示すタイミングで出力される各出力画素信号を一時的に記憶し、正しい画素順に並べ替えて出力する画素並べ替えを実現するためのものである。

【0048】DFE517及びメモリ518は、後述する図4に示すつなぎ位置（立ち上がりエッジ位置P-VCKで示す）の画素データをCPU519が取り込めるように一時的に保持する機能を果たす。CPU519は、原稿202の読み取り中に複数回に亘りメモリ518に保持された画素データを取り込み、後述の演算処理（図6のルックアップテーブル（LUT）設定処理）により、つなぎ補正のためのルックアップテーブルLUT-2、LUT-3、LUT-4の設定内容を決定する。なお、CPU519が実行するプログラムは不図示のROMに格納されている。

【0049】図4は、イメージセンサ208からの出力画素信号の出力状況を視覚的に示した図である。同図は、黒オフセット+シェーディング補正回路509、510、511、512による処理後の画素信号を示したものである。

【0050】同図において、HSYNCはライン同期信号である。立ち上がりエッジ位置P-VCKは、イメージセンサ208の受光画素列301の左右に分割した境界における画素信号の発生タイミングを規定する。画素信号番号1～2nは、読み出される画素信号の順番を表す。

【0051】同図に示すように、イメージセンサ208の左側の受光画素列301Lからの出力画素信号ODD-1、EVEN-1が、順次1番、2番というように交互に読み出され、受光画素列301Lの画素信号がn番目まで読み出されると、次に右側の受光画素列301Rからの出力画素信号ODD-2、EVEN-2が、順次n+1番、n+2番というように交互に読み出され、2n番目まで読み出されて1ライン分の有効画素データが

得られる。

【0052】このような順番で読み出しがなされる結果、立ち上がりエッジ位置P-VCKにおいては、出力画素信号ODD-1、EVEN-1、ODD-2、EVEN-2がn-1～n+2番目まで順番が連続する。後述するつなぎ補正はこれらn-1～n+2番目までの画素信号を用いて行われる。このようにするのは、これらの信号は原稿202における互いに近接した位置の画像から得られたものであり、各信号の本来の信号レベルは略一致していると考えられるからである。

【0053】なお、n-1～n+2番目以外の画素信号であっても、受光画素列301の分割位置近傍の画素信号を用いれば本実施の形態に近い効果は期待できる。

【0054】図5は、原稿202の明るさ（横軸）と出力画素信号ODD-1、ODD-2の信号レベル（縦軸）との関係を示す図である。同図（a）はつなぎ補正前、同図（b）は出力画素信号ODD-1を基準として出力画素信号ODD-2につなぎ補正を行った後における信号レベルを表す。

【0055】同図（a）に示すように、出力画素信号ODD-1、ODD-2は、出力アンプ306、307等の互いに異なる回路を経てデジタル信号に変換されるため、同一の明るさの原稿202を読み取った場合でも、読み取られた信号レベルに僅かに差異が生じ得る（同図「Δ」）。そこで、本実施の形態では、つなぎ補正回路514で出力画素信号ODD-1を基準チャンネルとして出力画素信号ODD-3を変換し、同図（b）に示すように出力画素信号ODD-1の信号レベルに一致させる。なお、出力画素信号EVEN-1、EVEN-2についても、つなぎ補正回路513、515にて同様にレベル変換することで、読み取り信号レベルを出力画素信号ODD-1の信号レベルに一致させる。

【0056】つなぎ補正回路513、514、515でのつなぎ補正は、ルックアップテーブルLUT-2、LUT-3、LUT-4に基づいて行われる。各ルックアップテーブルLUT-2、3、4は、後述するルックアップテーブル（LUT）設定処理によりその内容が設定される。

【0057】図6は、ルックアップテーブル（LUT）設定処理のフローチャートを示す図である。本処理では出力画素信号ODD-1を基準チャンネルとして出力画素信号ODD-2のレベル調整をするためのルックアップテーブルLUT-3の内容の設定処理を例にとるが、出力画素信号EVEN-1、EVEN-2についても同様に、出力画素信号ODD-1を基準チャンネルとしてレベル調整をするためのルックアップテーブルLUT-2、LUT-4の内容が設定される。

【0058】まず、つなぎ位置の画素データを取り込む（ステップS601）。すなわち、原稿読み取り中に、メモリ518に保持された図4に示す立ち上がりエッジ

信号EVEN-2のレベル調整は出力画素信号ODD-1ではなく出力画素信号EVEN-2を基準として行うようにしてもよい。

【0072】なお、本実施の形態では左右2分割の例を示したが、これに限るものでなく、複数に分割する場合において広く本発明を適用可能である。

【0073】(第2の実施の形態)第1の実施の形態では、ルックアップテーブルは原稿読み取り毎に新たに作り替えられることになるので、直前に読み取った原稿に強く依存した補正が行われることになる。本第2の実施の形態では、この不都合を回避するべく、ルックアップテーブルを部分的に更新するようにする。従って、第1の実施の形態とは図6のステップS606のテーブル設定処理が異なり、その他の構成は第1の実施の形態と同様である。

【0074】図10は、本実施の形態におけるルックアップテーブルLUT-3の内容の一例を示す図である。同図(a)は更新前、同図(b)は更新後の内容を示す。

【0075】前述したように、代表点は全てのブロックBについて得られるとは限らない。そのため、代表点が得られたブロックBについてのみ新たな代表点を用いてテーブル設定処理を行う。更新は、古い代表点を新たな代表点に単純に置き換えて上記補間演算によりルックアップテーブルLUT-3の内容を決定することにより行う。同図(b)に示す点p群が更新後の代表点である。なお、ルックアップテーブルLUT-2、4についても同様に処理される。

【0076】なお、古い代表点と新たな代表点との間で演算処理(例えば重み付け線形演算)を行って更新後の代表点を得るようにしてもよい。

【0077】本実施の形態によれば、ルックアップテーブルの設定に際し、直前に読み取った原稿による影響が過大になることを防止することができるので、第1の実施の形態と同様の効果を奏するだけでなく、より適切なつなぎ補正が可能になる。

【0078】(第3の実施の形態)図11は、本発明の第3の実施の形態に係る画像読み取り装置の読み取り部の構成を示す図である。本実施の形態に係る画像読み取り装置の構成は、基本的に第1の実施の形態と同様であるが、つなぎ補正回路900を黒オフセット+シェーディング補正回路509とメモリ516との間に設け、さらにつなぎ補正回路513、514、515に代えてつなぎ補正回路913、914、915を備えた点が相違する。つなぎ補正回路913、914、915は、つなぎ補正回路513、514、515と同様につなぎ補正を行うが、さらに画像の階調数の変換(bit変換)をも行う。

【0079】すなわち、つなぎ補正回路913、914、915には、黒オフセット+シェーディング補正回

路510、511、512からそれぞれ10bitの信号が入力され、ここで8bitの信号に変換されてメモリ516に出力される。また、つなぎ補正回路900には、黒オフセット+シェーディング補正回路509から10bitの信号が入力され、ここで下位2bitの信号が切り捨てられて、上位8bitの信号がメモリ516に出力される。

【0080】従って、つなぎ補正前までは大きい階調数(10bit)で処理してつなぎ補正の正確さを確保する一方、つなぎ補正後はより小さい階調数(8bit)で処理して負担を軽減する。なお、つなぎ補正前に対して補正後の階調数を小さくすればよく、上記10bitと8bitの組み合わせに限られない。

【0081】本実施の形態によれば、第1の実施の形態と同様の効果を奏するだけでなく、信号レベルの調整の精度を維持しつつ画像読み取り処理の負担を軽減することができる。

【0082】なお、上述した各実施形態の機能を実現するソフトウェアのプログラムコードを記録した記憶媒体を画像読み取り装置に供給し、その画像読み取り装置のコンピュータ(またはCPUやMPU)が記憶媒体に格納されたプログラムコードを読み出し実行することによっても、本発明の目的が達成されることはいうまでもない。

【0083】この場合、記憶媒体から読み出されたプログラムコード自体が本発明の新規な機能を実現することになり、そのプログラムコードを記憶した記憶媒体は本発明を構成することになる。

【0084】プログラムコードを供給するための記憶媒体として、例えば、フロッピーディスク、ハードディスク、光ディスク、光磁気ディスク、CD-ROM、CD-R、磁気テープ、不揮発性のメモリカード、ROMなどを用いることができる。

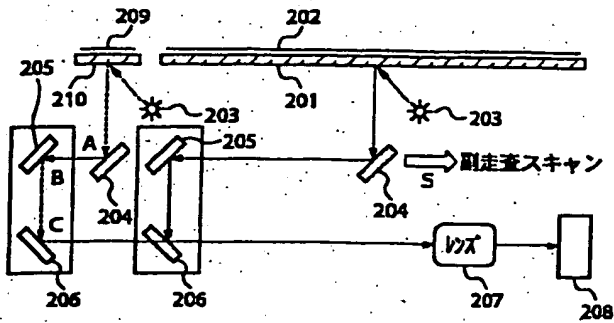
【0085】また、コンピュータが読み出したプログラムコードを実行することにより上述した各実施形態の機能が実現されるだけでなく、そのプログラムコードの指示に基づいて、コンピュータ上で稼動しているOS等が実際の処理の一部または全部を行い、その処理によって前述した実施形態の機能が実現される場合も含まれることはいうまでもない。

【0086】さらに、記憶媒体から読み出されたプログラムコードが、コンピュータに挿入された機能拡張ボードやコンピュータに接続された機能拡張ユニットに備わるメモリに書き込まれた後、そのプログラムコードの指示に基づいて、その機能拡張ボードや機能拡張ユニットに備わるCPU等が実際の処理の一部または全部を行い、その処理によって前述した実施形態の機能が実現される場合も含まれることはいうまでもない。

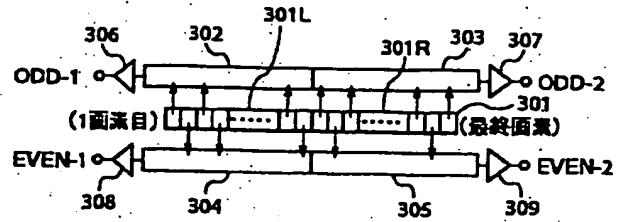
【0087】

【発明の効果】以上説明したように、本発明の請求項1

【図1】

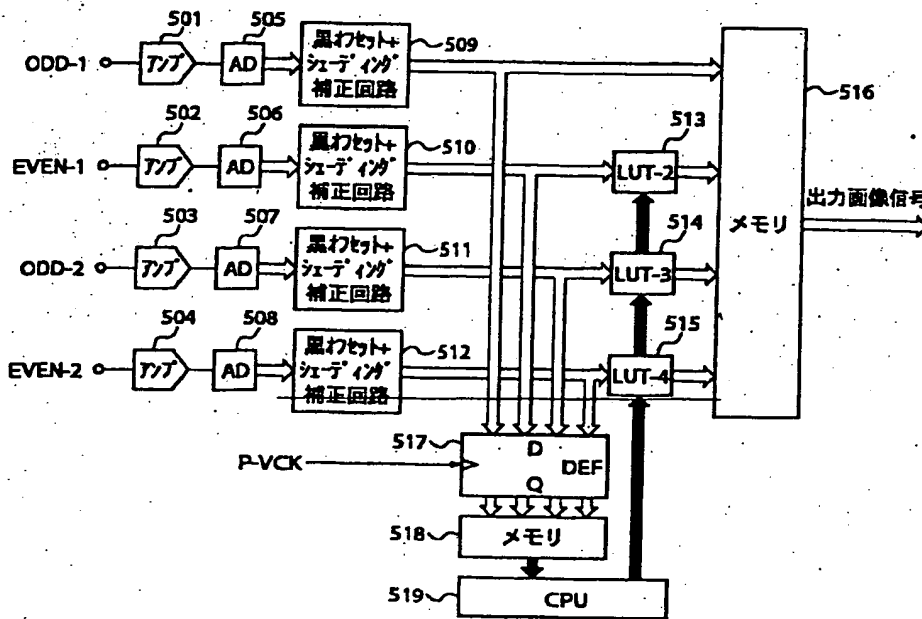


【図2】

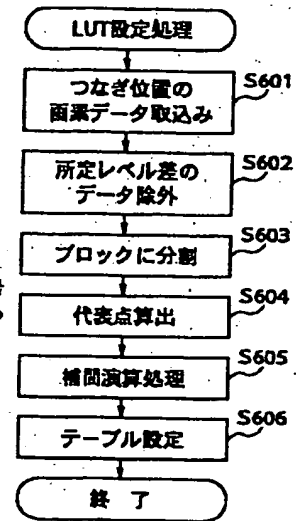
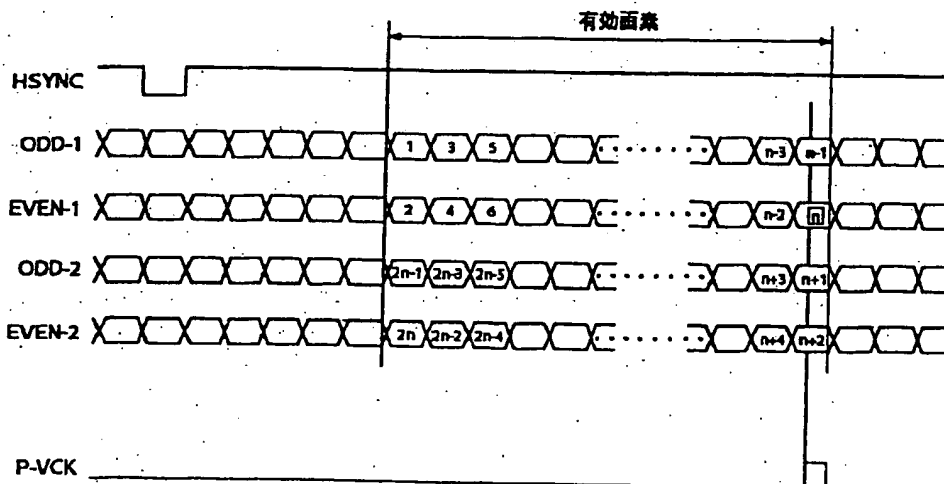


【図6】

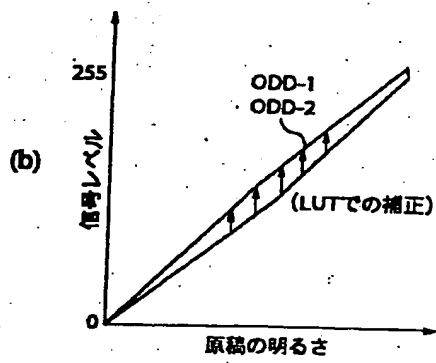
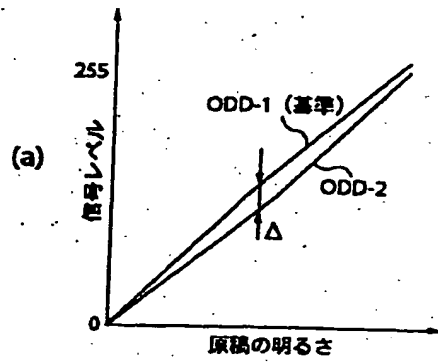
【図3】



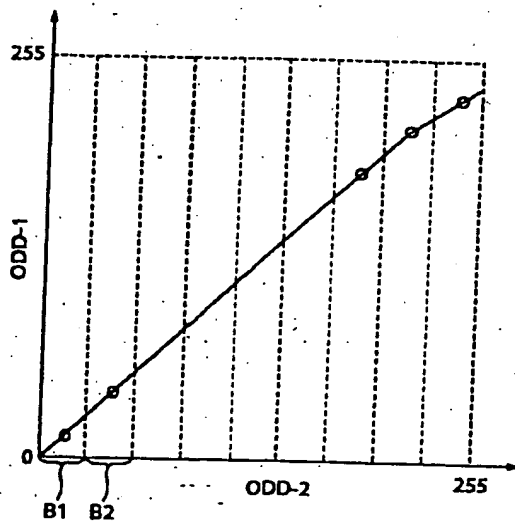
【図4】



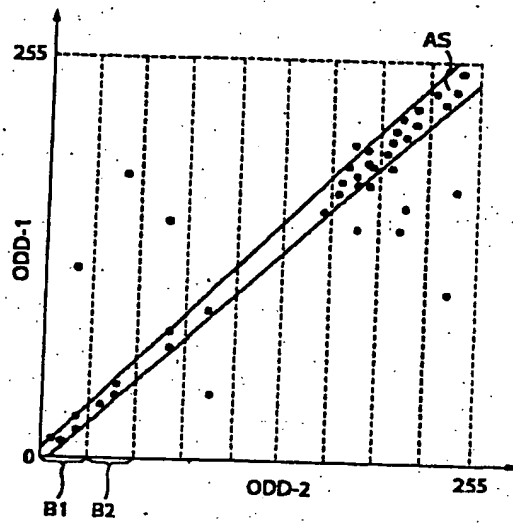
【図5】



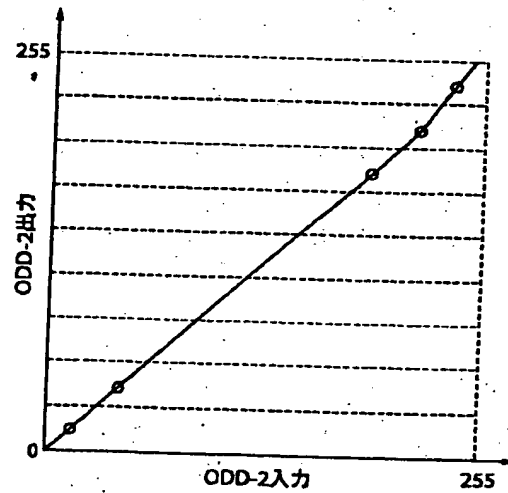
【図8】



【図7】



【図9】



【図12】

